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Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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FLOOD INSURANCE STUDY

CITY OF GLADSTONE,
CLAY COUNTY, MISSOURI

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Type 19 Flood Insurance Study is to investigate the existence and severity of flood hazards remaining in the City of Gladstone, Clay County, Missouri, due to increased development in the flood plain, updated methodology for computing discharges, and the rechannelization of Mill Creek, and to aid the administration of the Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to revise Flood Insurance Rate Maps developed from data presented in the Type 15 Flood Insurance Study. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 34. This study was completed in January 1982.

1.3 Coordination

Streams requiring detailed study were identified at a meeting in September 1980, attended by representatives of the Study Contractor, FEMA, and the City of Gladstone.

On September 30, 1985, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

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2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers portions of the incorporated areas of the City of Gladstone, Clay County, Missouri. The area of study is shown on the Vicinity Map (Figure 1). The limits of detailed study for Gladstone were determined by FEMA with city and Study Contractor consultation at the meeting held on September 1980.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction for the next five years, through January 1987.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by FEMA and the City of Gladstone.

Flooding caused by the overflow of Rock Creek Tributary, from the eastern corporate limits to about 1.21 miles upstream of Prospect Avenue North; Mill Creek, from the southern corporate limits to about 0.61 mile upstream of North Highland Street; and East Creek, from the western corporate limits to about 0.15 mile upstream of Apartment Driveway was studied in detail. Flooding caused by Shoal Creek within the corporate limits was studied in detail in the Type 15 Flood Insurance Study (Reference 1) and the data have been included in this study.

2.2 Community Description

The City of Gladstone is located in southwest Clay County, in northwestern Missouri, approximately nine miles north of the downtown portion of the City of Kansas City, and is entirely surrounded by Kansas City.

The city was founded by W.E. Winner in the 1800's. The town was called Linden and was bound by the now-named streets from North Troost to North Oak and from 68th Terrace to 72nd Street. The Kansas City and Atlantic Railroad went through Linden and then turned north to connect with a line to Quincy, Illinois. By 1895, the population had grown to 400, and the boundaries had extended. The year 1949 was the beginning of considerable growth in the area. As Kansas City was growing and expanding its influence into Clay County, the growth of the Linden area was stimulated and increased in proportion.

In 1952, the City of Gladstone was incorporated. Wooded areas and farmland gave way to large housing projects, and the population rose to 23,422 in 1970, an increase of 62 percent from the 1960 figure of 14,502. The 1980 population was 24,990 (Reference 2). This growth has been characteristic since the early 1950s with Kansas City's influence north of the Missouri River, the opening of the Paseo, Broadway, and Choteau Bridges, and the completion of Interstate Highways 35 and 29. Population is expected to increase much slower in the future as Gladstone nears full development. Presently, Gladstone is over 60 percent developed and almost totally residential in the areas of Rock Creek Tributary, Mill Creek, and

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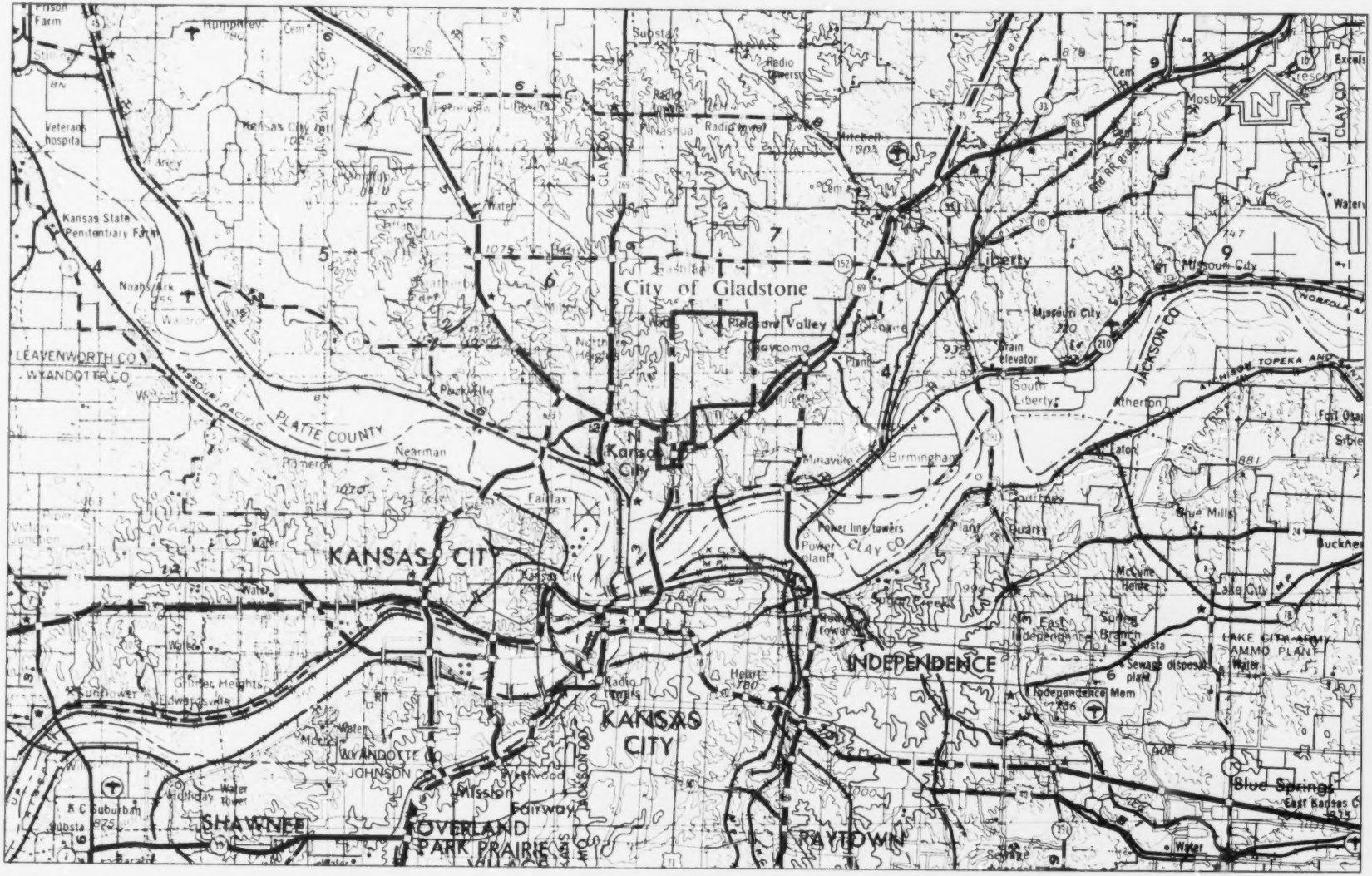

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO

(CLAY CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

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East Creek. Land around Shoal Creek appears to be in reserve for future residential growth, but the area is presently undeveloped. The climate in Gladstone is typical of the Kansas City area. Temperatures range from a high of 113 degrees Fahrenheit (F.) as recorded in August 1936, to a low of -22 degrees F., as recorded in February 1899. The average maximum temperature in the area is 64.8 degrees F.; the average minimum temperature is 46.3 degrees F. (Reference 3).

The average annual precipitation in the area is 36.7 inches, based on records from 1935 to 1974. Heaviest rainfall is expected during the spring and summer months, and the driest period occurs from November to March. The heaviest precipitation recorded for a period was 7.03 inches in September 1914. Humidity is normally greater than 60 percent, due to the abundance of precipitation, the numerous rivers, and the currents of warm, moist air from the Gulf of Mexico (Reference 3).

The topography of Gladstone consists of low, open hills. Vegetation is plentiful, being most prevalent along the creek beds. A variety of trees and shrubs exist, including elm, hackberry, hickory, ash, locust, willow, sycamore, cottonwood, and oak. Along parts of the creeks, areas of scrub and brush exist.

In general, Gladstone is located in the Line Creek and Shoal Creek watersheds. In the western half of the city, two branches of Line Creek have their beginning. East Creek and an unnamed tributary begin in the southern portion and flow in a southwesterly direction, converging into Line Creek approximately 2 miles southwest of Gladstone in the Northmoor area. Shoal Creek begins north of Gladstone in the Gashland area and flows in a southeasterly direction through the northeast quandrant of the city. Rock Creek Tributary, a branch of Mill Creek, has its source in central Gladstone, where it has several branches, and flows in a southeasterly direction, leaving the city at the southeast corner. From there, Rock Creek Tributary converges with Mill Creek, which meanders through parts of Kansas City and Claycomo before joining Shoal Creek. Mill Creek begins in the Oakwood Manor community, in south-central Gladstone, leaving the city at its south boundary, approximately at Antioch Road.

2.3 Principal Flood Problems

Flooding in the city results from high intensity rainfall due to thunderstorm activity, with the heaviest flooding occurring along Shoal and Rock Creeks.

Heavy rains in spring 1974 caused flooding at Shady Lane, west of North Bales Street, when waters from Rock Creek Tributary flooded backyards and basements, and reached heights exceeding the tops of curbs and resulted in the flooding of the entire cul-de-sac. Similar conditions occurred at 69th Street and Woodland Avenue, 72nd Street and Highland Avenue, and 64th and Bellfontaine Streets. In a new residential development east of North Bales Street, called Brooktree, homes were inundated at least 5 feet deep and damage to private property was $300,000. Flooding also occurred the same year to homes at 58th Terrace and Mill Creek.

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2.4 Flood Protection Measures

Presently, no flood protection measures have been incorporated by the city. Only recently, with the intensive growth the area has experienced, has the city been able to identify the various problems. Some consideration has been given to the possibility of incorporating a series of holding ponds along Rock Creek Tributary to control runoff. In August 1983, the citizens of Gladstone approved a bond issue for $1.5 million worth of stormwater improvements. This work is scheduled to start in March 1984.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 per cent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one per cent chance of annual occurrence) in any 50-year period is about 40 per cent (four in ten), and for any 90-year period, the risk increases to about 60 per cent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

Peak discharges for Rock Creek Tributary, Mill Creek, and East Creek were computed using the Storm Water Management Model (SWMM) computer program (Reference 4). This program utilized rainfall from the Weather Bureau Technical Paper No. 40 (Reference 5). Input factors for the program include slope, Manning's "n" values, area, length, width, and depth; some of which were obtained from U.S. Geological Survey (USGS) topographic maps (Reference 6). Other input values used in the program include infiltration rate, surface storage factor, and percent imperviousness.

Decreasing discharges along Rock Creek Tributary are due to storage in the overbank. Peak discharges for Shoal Creek were based on the generalized flood-frequency estimates for urban areas in Missouri, prepared by the USGS (Reference 7).

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

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TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ROCK CREEK TRIBUTARY					
just downstream of corporate limits	2.65	1,436	2,337	2,684	3,674
about 1,150 feet downstream of Indiana Avenue	2.53	1,428	2,346	2,691	3,689
about 150 feet downstream of Indiana Avenue	2.41	1,415	2,334	2,679	3,674
at Brooktree Lane	2.18	1,544	2,676	3,111	4,334
about 800 feet upstream of Brooktree Lane	2.07	1,408	2,412	2,801	3,913
about 200 feet downtream of Antioch Road	1.98	1,389	2,363	2,737	3,833
about 700 feet upstream of Antioch Road	1.53	1,132	1,916	2,206	3,085
about 1,400 feet upstream of North Prospect	1.36	1,148	1,901	2,189	3,031
about 2,200 feet upstream of North Prospect	1.14	1,039	1,719	1,973	2,724
about 1,300 feet downstream of 72nd Street	0.69	738	1,202	1,381	1,892
EAST CREEK					
about 400 feet downstream of North Broadway	0.65	834	1,426	1,661	2,307
about 500 feet upstream of North Broadway	0.52	713	1,214	1,388	1,921
about 250 feet upstream of East Creek and 59th Place	0.44	615	1,043	1,219	1,719
about 250 feet downstream of 61st Street	0.42	610	1,038	1,197	1,630
at 61st Street	0.37	575	955	1,094	1,539
MILL CREEK					
just downstream of corporate limit	0.25	1,325	2,057	2,333	3,122
about 280 feet downstream of North Euclid	0.67	772	1,215	1,383	1,888
about 1,000 feet upstream of North Michigan	0.53	789	1,210	1,371	1,854
about 500 feet downstream of North Flara and Mill Creek intersection	0.25	522	804	916	1,231
SHOAL CREEK					
about 625 feet downstream of Antioch Road	12.0	3,000	6,000	7,600	12,500

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3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross sections for the backwater analyses of Rock Creek Tributary, Mill Creek, and East Creek were obtained from aerial photographs taken on April 11, 1975. Mapping made from the aerial photographs has a scale of 1:1200 with a 2 foot contour interval (Reference 8). All bridges were field surveyed in order to obtain bridge structural geometry. Cross sections for Shoal Creek were obtained from a previous study (Reference 9).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map.

Channel roughness factors (Manning's "n"), used in the hydraulic computations, were chosen by engineering judgment and based on inspection of the flood plain areas. Roughness factors for the streams studied in detail were generally as follows:

LOCATION	STREAM CHANNEL	OVERBANK
Shoal Creek	.08	.08
Rock Creek Tributary	.035 - 0.65	.04 - .08
Mill Creek	.02 - .06	.02 - .075
East Creek	.035 - .06	.05 - .06

The starting water-surface elevation for Mill Creek, East Creek, and Rock Creek Tributary was critical depth with minor adjustments for stream conditions. The starting water-surface elevation for Shoal Creek was taken from the Kansas City, Missouri, Flood Insurance Study (Reference 10).

Water surface elevations of floods of the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater program (Reference 11). Cross sections for the backwater analyses were located at close intervals above and below bridges in order to compute the significant backwater effects of these structures.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

Elevations for streams studied by approximate methods were determined by slope-area analysis.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

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4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by FEMA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using topographic maps at a scale of 1:1200 with a contour interval of 2 feet (Reference 8). Boundaries of the tributary to East Creek, studied by approximate methods, were taken directly from the Type 15 Flood Insurance Study (Reference 1). Boundaries for Shoal Creek were also taken directly from the Type 15 Flood Insurance Study.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map. Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of FEMA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE (FEET)
ROCK CREEK TRIBUTARY							
A	5770	67	382	7.0	849.4	848.8	0.6
B	6863	140	957	2.8	856.9	856.6	0.3
C	7675	64	491	5.5	858.3	857.8	0.5
D	8225	152	524	5.1	859.7	859.1	0.6
E	8937	158	1115	2.4	867.5	867.1	0.4
F	9113	116	869	3.1	867.6	867.2	0.4
G	9380	57	422	6.4	867.8	867.3	0.5
H	9588	181	1503	2.1	871.0	870.4	0.6
I	9895	289	2373	1.3	871.1	870.5	0.6
J	10,135	165	1248	2.5	871.2	870.6	0.6
K	10,435	256	1648	1.9	871.4	870.8	0.6
L	10,890	56	300	10.4	871.4	870.8	0.6
M	11,765	85	415	6.7	876.8	876.5	0.3
N	12,657	114	815	3.4	886.2	886.1	0.1
O	13,665	68	360	6.1	889.5	888.8	0.7
P	14,835	99	692	3.2	898.8	898.8	0.0
Q	16,215	73	450	4.9	904.9	904.0	0.9
R	17,095	82	512	4.3	910.9	909.9	1.0
S	17,785	55	410	4.8	912.4	911.5	0.9
T	18,805	45	222	8.9	918.9	918.9	0.0
U	19,725	116	663	3.0	923.2	922.4	0.8
V	20,445	39	209	6.6	925.5	924.7	0.8
W	21,175	39	222	6.2	929.1	928.2	0.9

[1]FEET ABOVE CONFLUENCE WITH MILL CREEK

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO

(CLAY CO.)

FLOODWAY DATA

ROCK CREEK TRIBUTARY

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE (FEET)
MILL CREEK							
A	33,284	64	306	7.6	887.6	887.6	0.0
B	33,821	79	500	4.7	892.6	892.5	0.1
C	34,793	98	660	3.5	897.6	896.6	1.0
D	35,341	58	389	6.0	899.0	898.2	0.8
E	35,851	92	428	5.4	905.9	905.9	0.0
F	36,531	39	318	4.4	911.9	911.3	0.6
G	37,135	50	413	3.3	916.9	916.7	0.2
H	38,081	104	408	3.4	919.6	918.9	0.7
I	38,826	70	286	4.8	925.6	925.4	0.2
J	39,646	34	160	8.5	937.3	937.3	0.0
K	40,276	68	164	5.6	947.2	947.1	0.1

[1]FEET ABOVE CONFLUENCE WITH SHOAL CREEK

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO

(CLAY CO.)

FLOODWAY DATA

MILL CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE (FEET)
SHOAL CREEK							
A	16.40	173	947	8.0	827.3	826.5	0.8
B	16.44	372	2572	3.0	829.0	828.4	0.6
C	16.76	274	1910	4.0	834.6	834.6	0.0
EAST CREEK							
A	13,980	80	281	5.9	869.4	869.3	0.1
B	14,250	78	565	2.9	873.9	872.9	1.0
C	14,772	46	193	7.2	875.5	874.7	0.8
D	15,291	39	164	8.4	880.8	880.4	0.4
E	15,586	135	437	3.2	885.4	885.1	0.3
F	15,901	29	109	11.1	887.0	887.0	0.0
G	16,136	100	370	3.3	892.9	892.2	0.7
H	16,679	40	174	6.9	900.7	900.1	0.6

[1]MILES ABOVE CONFLUENCE WITH MISSOURI RIVER
[2]FEET ABOVE CONFLUENCE WITH LINE CREEK

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TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO

(CLAY CO)

FLOODWAY DATA

SHOAL CREEK - EAST CREEK

As shown on the Flood Boundary and Floodway Map, the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

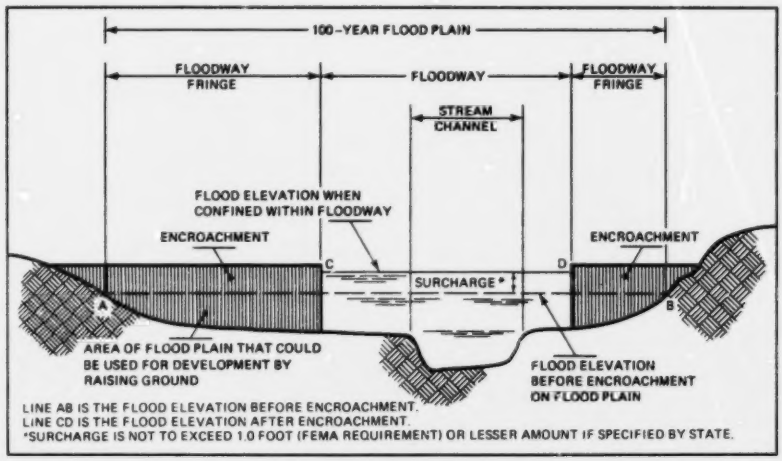
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, FEMA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the City of Gladstone.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 per cent of the reach.

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Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the City of Gladstone are shown on the Flood Profiles and are summarized in Table 3, "Flood Insurance Zone Data."

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the City of Gladstone was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.

Zones A3, A4, A9: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.

Zone B: Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to

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certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Gladstone is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by FEMA.

6.0 OTHER STUDIES

A Flood Insurance Study for the City of Gladstone was completed in March 1977 (Reference 1). Due to changes in the flood plains, the present study was authorized. Due to revised hydrology and rechannelization, the Mill Creek profiles show lower elevations in this study than compared to the Type 15 Flood Insurance Study. Rock Creek Tributary elevations are also lower due to decreased discharges. East Creek was studied in detail in this study, whereas it was studied by approximate methods in the Type 15 Flood Insurance Study. Urbanization has affected all streams.

A Flood Plain Information Report, which included Rock Creek Tributary and Shoal Creek (Reference 9) was prepared by the COE in 1974. Differences in flood elevations reflect changes that have occurred in the flood plain areas since the other study was completed and since the correlation of errors in original hydraulic calculations. Because profiles in the present study reflect the existing flood situation in Gladstone, they supersede those in the earlier report.

A Type 19 Flood Insurance Study is in progress for the adjacent City of Kansas City, Missouri (Reference 12). Results of that study are in agreement with the material presented in this report.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, 911 Walnut Street, Kansas City, Missouri 64106.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[2] (FEET NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
ROCK CREEK TRIBUTARY							
REACH 1	0001	−2.1	−0.5	0.9	020	A4	VARIES-SEE MAP
MILL CREEK							
REACH 1	0001	−1.4	−0.3	0.8	015	A3	VARIES-SEE MAP
SHOAL CREEK							
REACH 1	0001	−4.5	−1.6	3.2	045	A9	VARIES-SEE MAP
EAST CREEK							
REACH 1	0003	−1.3	−0.2	0.6	015	A3	VARIES-SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO

(CLAY CO.)

FLOOD INSURANCE ZONE DATA

ROCK CREEK TRIBUTARY—
MILL CREEK—SHOAL CREEK—EAST CREEK

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8.0 REFERENCES AND BIBLIOGRAPHY

1. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Gladstone, Clay County, Missouri, March 1977.

2. U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Missouri, Washington, D.C., February 1982.

3. ————, National Oceanic and Atmospheric Administration, National Climatic Center, Annual Summary of Climatological Data for Missouri, Asheville, North Carolina, 1978.

4. U.S. Environmental Protection Agency, Stormwater Management Model, March 1975.

5. U.S. Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, Washington, D.C., January 1963.

6. U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24000, Contour Interval 10 feet: North Kansas City, Missouri, 1975.

7. ————, Water Resources Division, Generalized Flood-Frequency Estimates for Urban Areas in Missouri, 1971.

8. M.J. Hardin Associates, Inc., Photogrammetric Engineers, Kansas City, Missouri, Aerial Photographic Map, Scale 1:1200, Contour Interval 2 feet, April 1975.

9. U.S. Army Corps of Engineers, Kansas City District, Flood Plain Information Report, Shoal Creek Basin, Kansas City, Missouri, September 1974.

10. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Kansas City, Jackson, Clay, and Platte Counties, Missouri, January 1975.

11. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profile, Computer Program 723-X6-L202A, Davis, California, August 1969.

12. Federal Emergency Management Agency, Flood Insurance Study, City of Kansas City, Clay, Platte, and Jackson Counties, Missouri, in progress.

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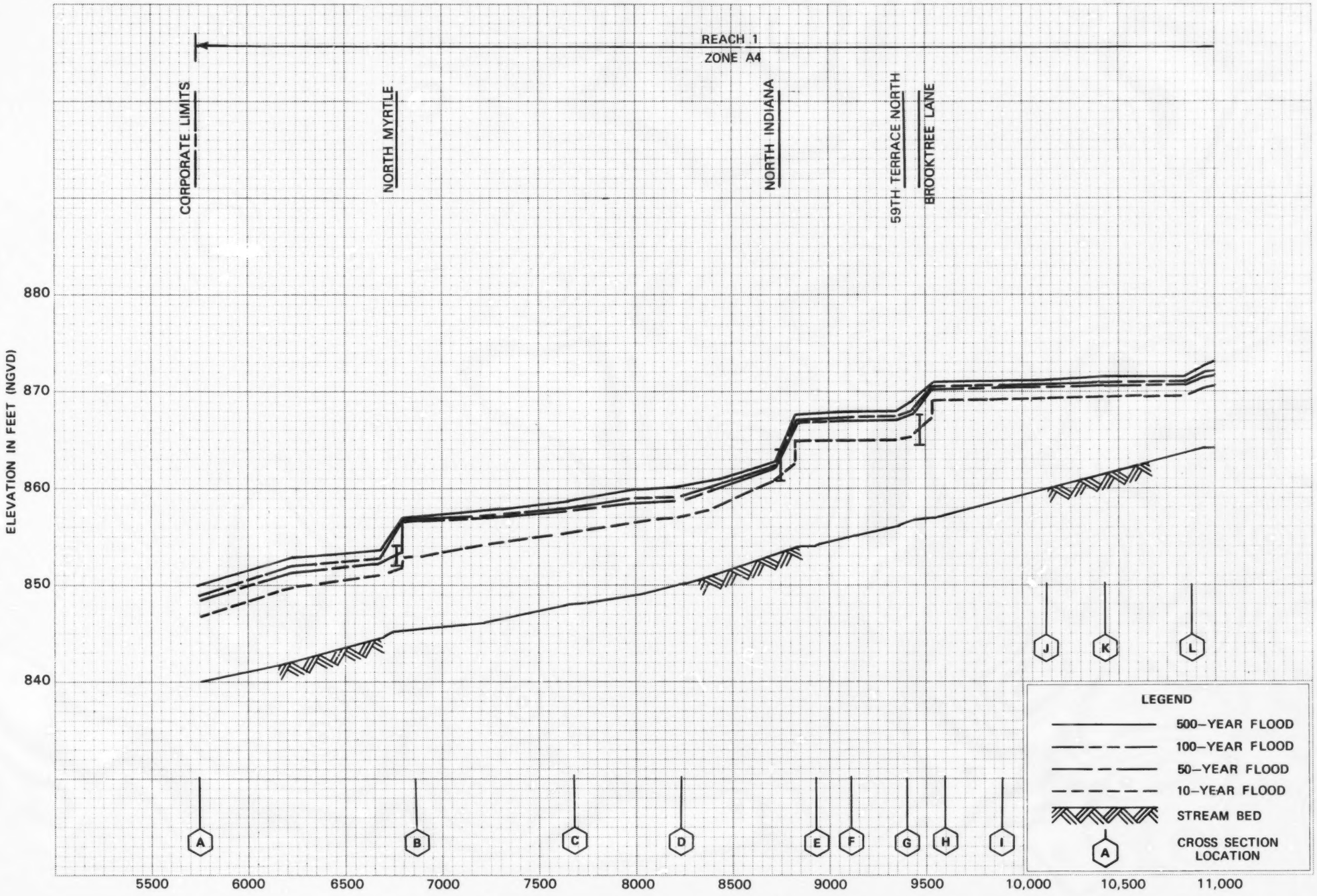

FLOOD PROFILES

ROCK CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO
(CLAY CO.)

01P

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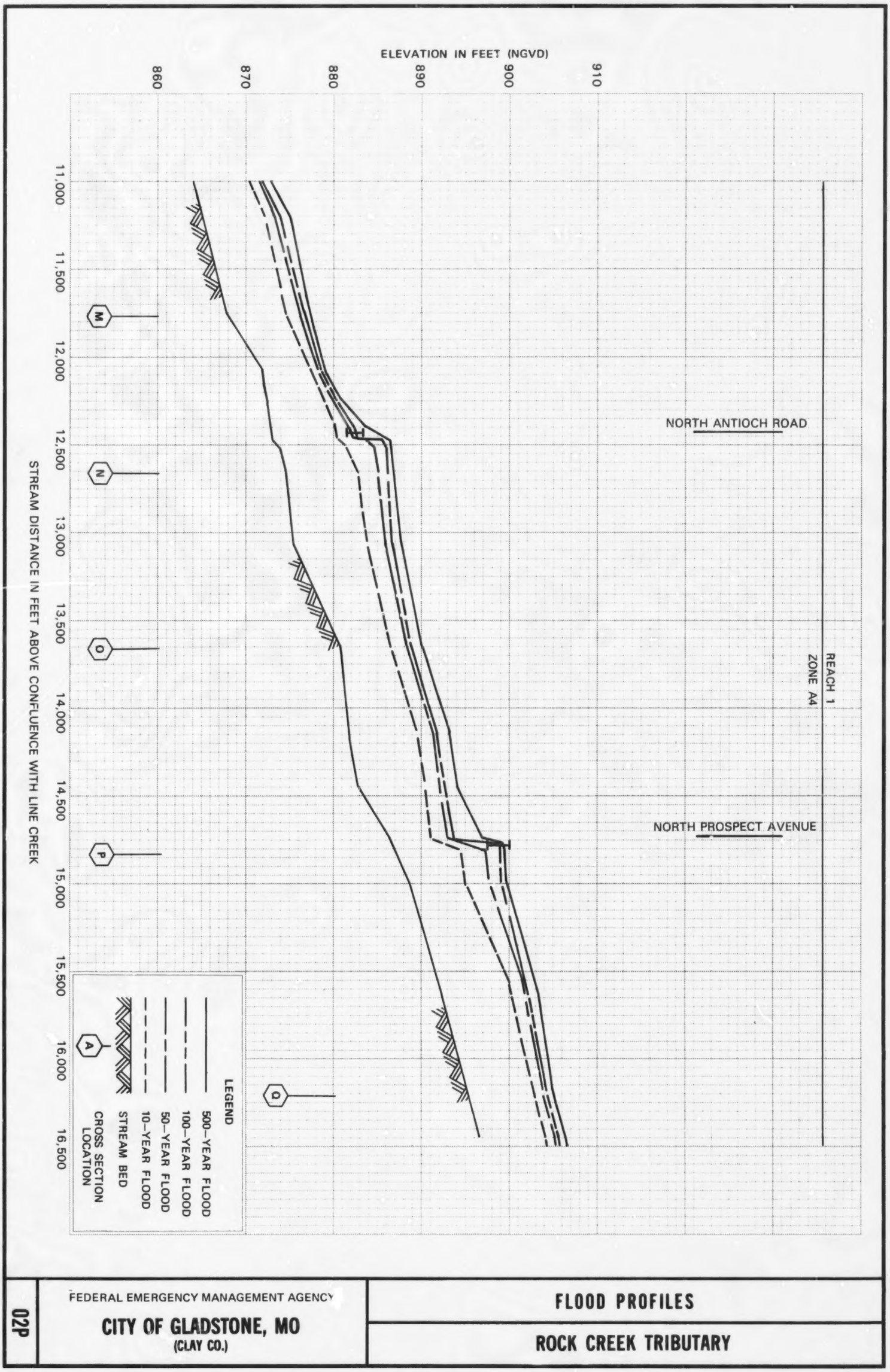

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO
(CLAY CO.)

FLOOD PROFILES

ROCK CREEK TRIBUTARY

02P

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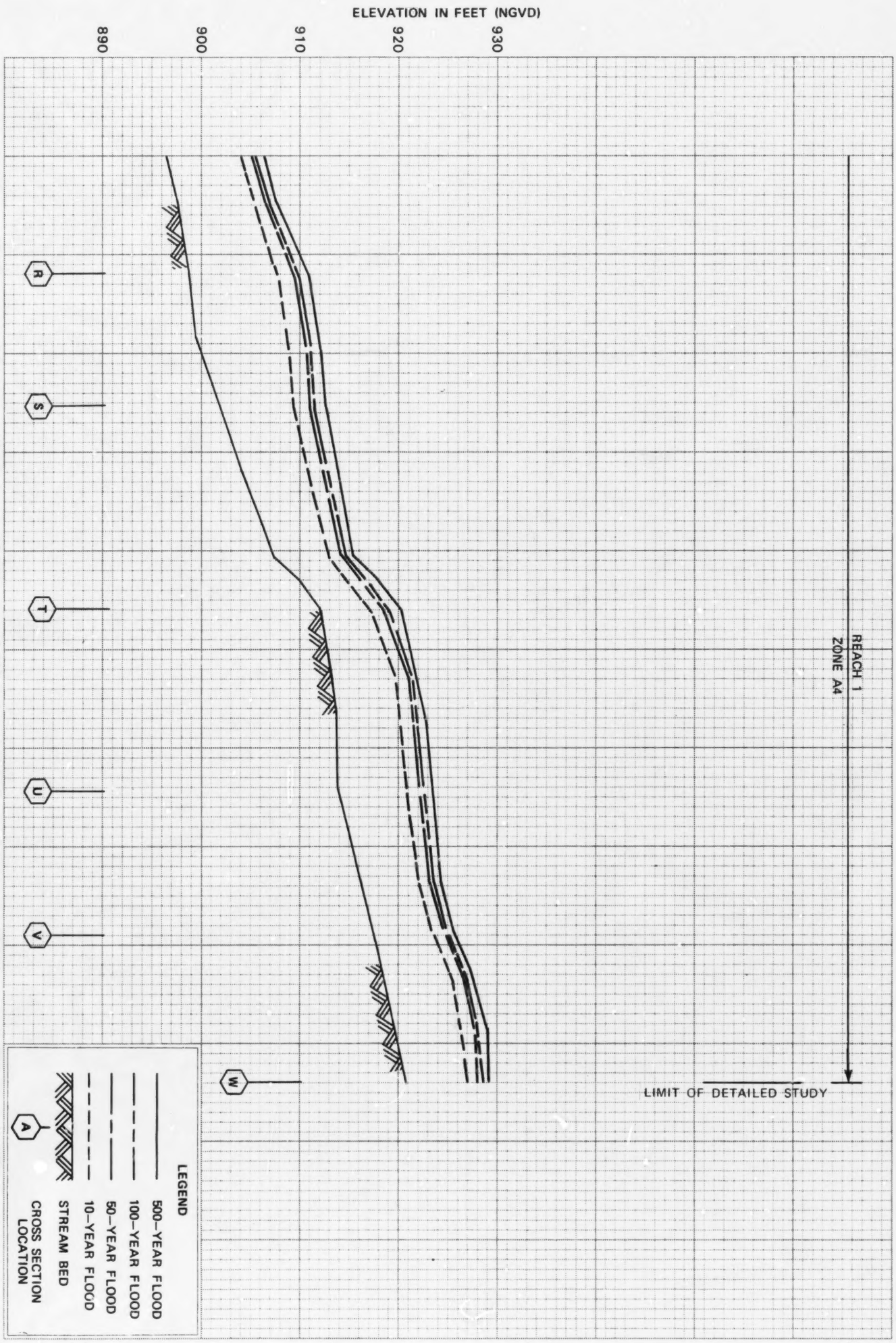

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO
(CLAY CO.)

FLOOD PROFILES

ROCK CREEK TRIBUTARY

03P

19

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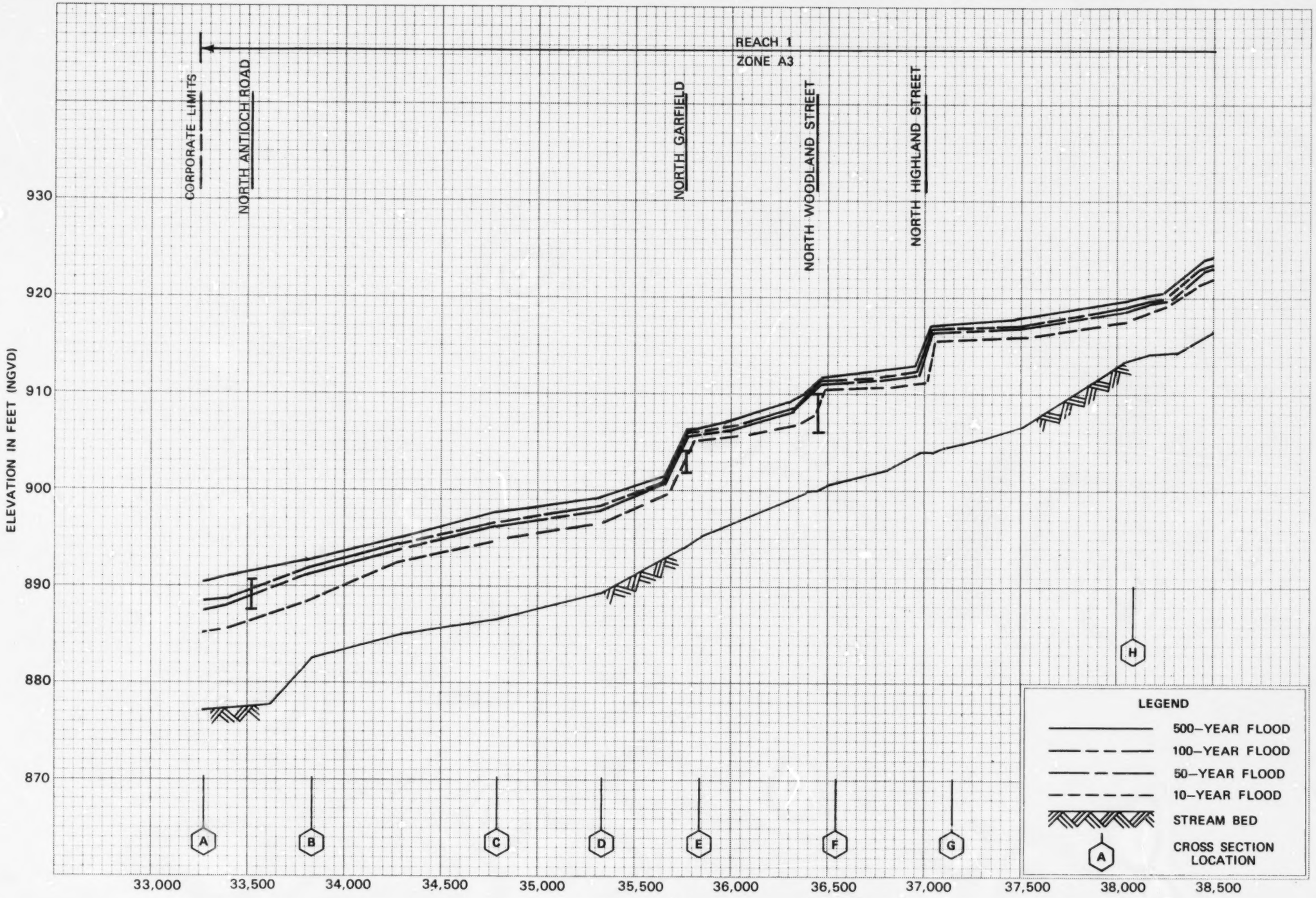

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO
(CLAY CO.)

04P

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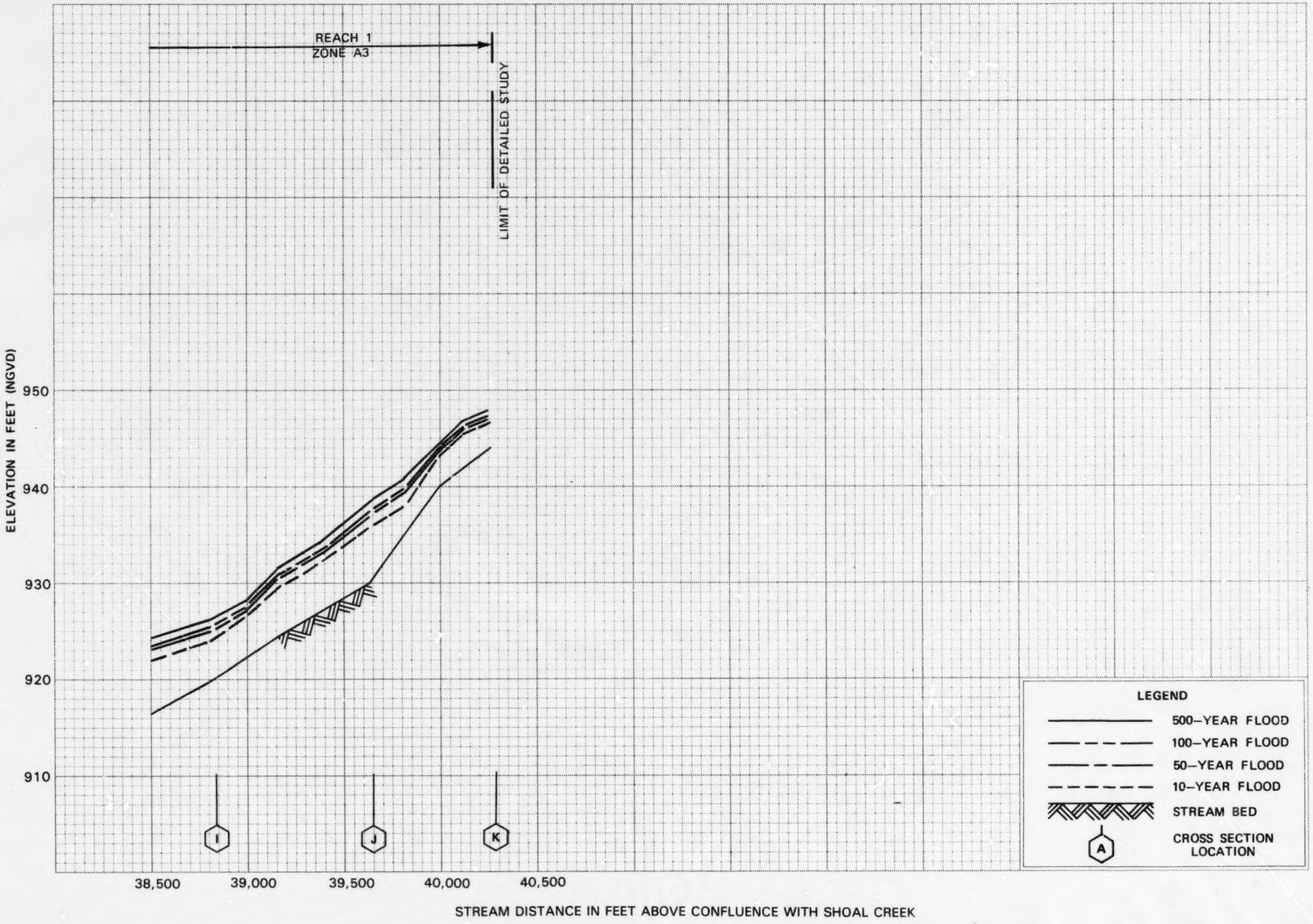

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO
(CLAY CO.)

05P

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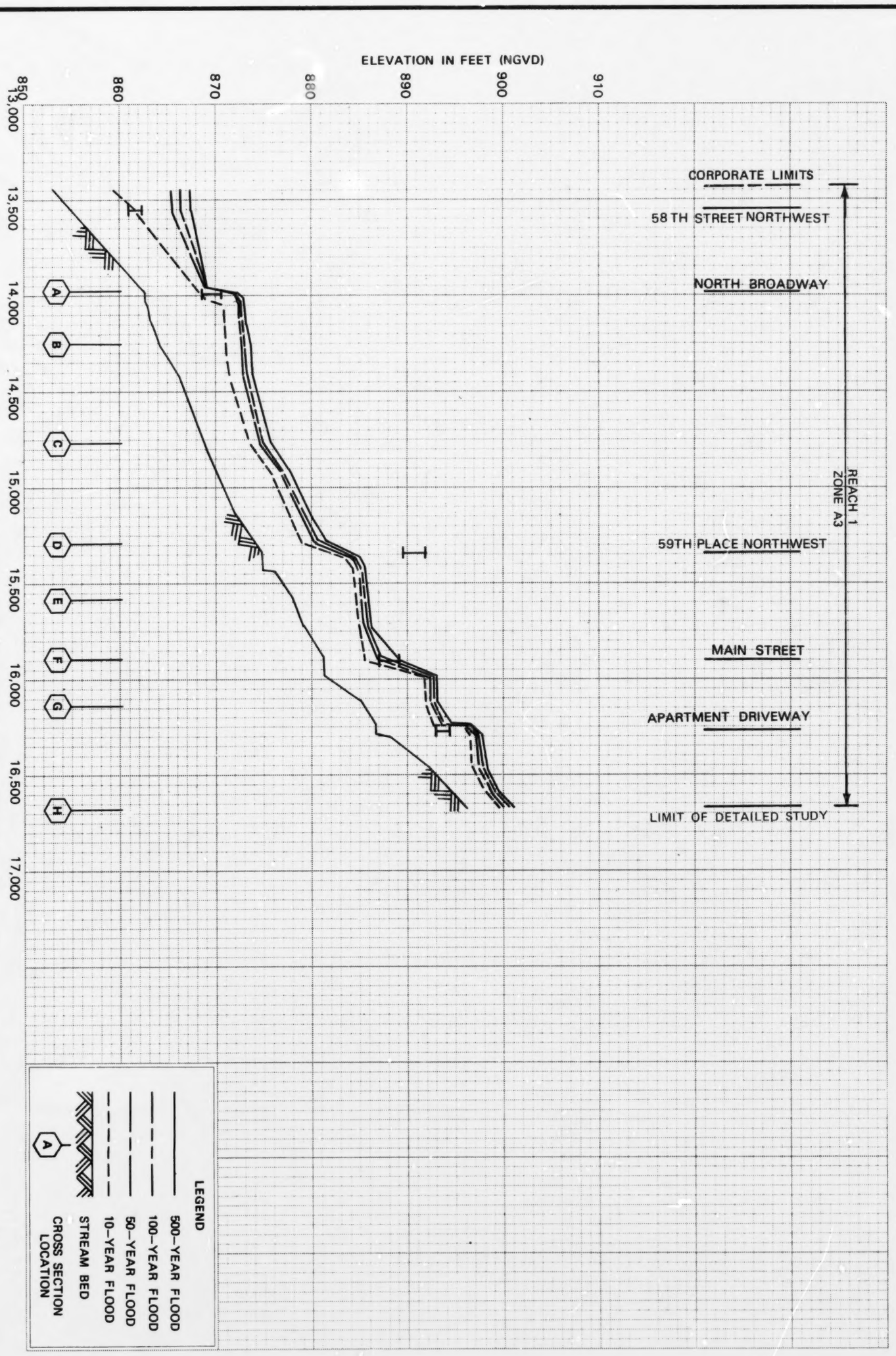

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO
(CLAY CO.)

FLOOD PROFILES

EAST CREEK

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22

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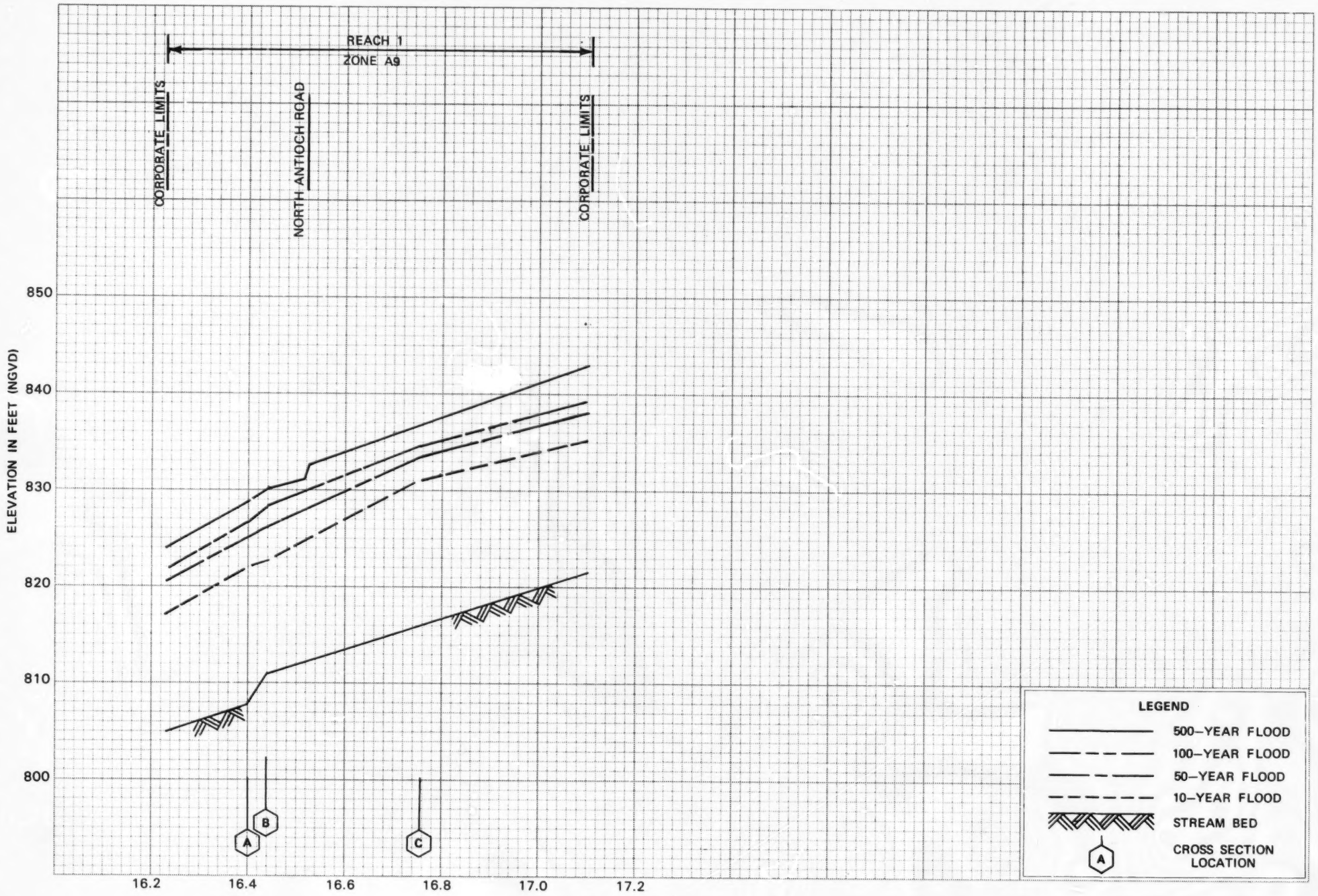

FLOOD PROFILES

SHOAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GLADSTONE, MO
(CLAY CO.)

07P

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